ISOTOPE HYDROLOGY AND GEOCHEMISTRY IN GEOTHERMAL FIELDS (ELS/8/005) F2 New

CORE FINANCING

YEAR	Experts		Equipment	Fellowships		Scientific Visits		Training	Sub-contracts	Misc. Comp.	Total
	m/d	US $	US $	m/d	US $	m/d	US $	US $	US $	US $	US $
1995	1/ 0	11,400	17,000	4/ 0	13,200	-	-	-	10,000	-	51,600
1996	2/15	30,000	5,000	-	-	-	-	-	10,000	-	45,000

First Year Approved: 95

OBJECTIVES: To identify suitable sites for production and injection wells in the Berlin and Ahuachapan geothermal fields and to explore other geothermal areas.

BACKGROUND: In El Salvador about 14% of the electrical power generated is supplied by geothermal energy resources. El Salvador, after the peace accord of 1992, is starting a national reconstruction plan highly dependent on power generation. Future electricity expansion is based on the additional development of geothermal resources. The expansion will amount to 24% in the year 2000 and the contribution to consumption will be about 39% of the total electricity generation. The Rio Lempa Executive Hydroelectric Commission (CEL) is an autonomous public service institution responsible for electricity production and development as well as for the conservation, utilization and administration of energy resources. Since 1984 the Agency has supported CEL through the projects ELS/8/002 and ELS/8/003 for the development of the Ahuachapan and Berlin fields. Laboratory and field equipment has been provided and the staff gained experience in the use of isotope techniques through expert assistance and training. In CEL's plan for 1990-2010, which is part of the Government's economic and social development plan, priority has been given to geothermal development for the expansion of the Ahuachapan and Berlin geothermal fields and to the exploration of San Vicente, Coatepeque and Chipilapa. By the year 2000 the expected increase in generating capacity is about 100%. Ahuachapan will increase from 42 to 90 MW(e) within five years, with the addition of 15 production and injection wells; Berlin will increase from 5 to 50 MW(e) in three years, with 18 additional wells. In the same field, CEL has planned to drill two injection wells for wastewater disposal in 1995. These projects will be funded by the Interamerican Development Bank (IDB). Drilling costs per well are currently estimated at about $2 million, so their proper siting is essential. Under the present project several experiments using stable and artificial tracers will be conducted to identify suitable areas for the location of producing wells or for injection of wastewaters generated during the exploitation. These isotope data will characterize the hydrology of the fields under exploration; they will also provide an estimate of the temperature in the reservoir, and allow the physico-chemical processes undergone by the fluids as well as the interaction of water and rocks to be understood. This information will help in the exploration, drilling and exploitation strategies of the geothermal resources. The results of the isotope technique, integrated with geological, geophysical and geochemical information, will provide the required hydrogeological model needed to identify target areas for drilling wells. The isotope data will be generated continuously even during exploitation of the geothermal resource to enable the reservoir to be monitored. The dynamic physico-chemical processes resulting from extraction of fluids can cause mixing of waters of different origins, reduction in reservoir pressure and formation of a steam layer which can be understood and identified from isotope data. This understanding will facilitate better strategies for reservoir exploitation and management so that the economic life of the resource can be optimized. In producing wells, experiments using iodine-131 and iodine-125 will be conducted to quantify the rate and direction of flow of injected waters towards the reservoir. The monitoring activities require regular isotope analysis during the economic life of the reservoir, thereby creating the need for laboratory facilities for stable isotopes. The project ELS/8/004 was approved as part of the 1993-94 programme with footnote-a/ status. This project aims to establish a stable isotope laboratory for analysis of geothermal samples. CEL has been operating the Ahuachapan and Berlin geothermal fields, where hydrological models have been generated from geoscientific data. The last two TC projects have produced results which will assist in the implementation of this proposed project, and the existing geochemical and geological activities of CEL would provide a basis for the work.

PROJECT PLAN: Water and steam samples from all producing and injection wells as well as from hot and cold springs and rivers, including those in exploration areas, will be collected and analysed for chemistry, oxygen-18 and deuterium. Samples from wells will be periodically collected as part of the reservoir monitoring programme. Approximately 200 samples will be measured within two years, and the results will be translated as maps to improve understanding of the movements of fluids. The evolution of fluids through time will be interpreted in graphs. Tracing with the use of I-131 or I-125 will be undertaken in producing fields where wells are available for monitoring. The injection of the tracer and the counting will be conducted by the local counterparts. About seven experiments are anticipated and about 800 samples will be measured in CEL's laboratory. The results will quantify the rate and direction of flow of injected waters towards the reservoir. The data will be interpreted by the Agency experts in collaboration with the counterparts. It will integrate the isotope, geochemical and reservoir engineering parameters to generate a conceptual understanding of the geothermal systems under exploitation. The results are expected to indicate which areas are most suitable sites for injection and production of steam.

NATIONAL COMMITMENT: A group of qualified engineers, chemists and geologists have been assigned to the project. Specialized field equipment and vehicles are available, as well as laboratory facilities consisting of: analytical chemistry laboratories for water and gas analysis; instruments such as spectrophotometry (UV and visible), atomic absorption, gas chromatography and cation chromatography to determine the chemical composition of fluids in the geothermal system; a petrological laboratory specializing in rock analysis and X-ray diffractometry to establish the petrological characteristics of the geological formations in the geothermal zones; a petrophysics laboratory to investigate the properties of cores extracted during drilling of the boreholes; a radioisotope laboratory with a liquid scintillation system. Facilities for maintenance and support of laboratory and field equipment and operational budget have been allocated.

AGENCY INPUT: Expert services on isotope hydrology, geochemistry, artificial tracing, data interpretation and reservoir modelling; equipment including a gas detector; isotope analysis; training.

IMPACT: The isotope data, complemented by chemical and hydrological parameters, will enable suitable sites for drilling production and injection wells to be identified. This will increase the ratio of success for siting drilling areas and could reduce the costs of wells. The injection of wastewaters will protect the groundwater, surface water and agricultural resources from potential pollution. It will also maintain the pressure in the reservoir and induce artificial recharge of the resource, thus ensuring the renewal, reheating and availability of fluids to be tapped. In the long term, the development of geothermal areas will increase the production of electricity from indigenous resources such as geothermal energy, which will reduce dependence on imported fuel and conserve foreign exchange.